



## Micro injection moulding process optimization of an ultra-small POM three-dimensional component

Baruffi, Federico; Calaon, Matteo; Tosello, Guido

*Publication date:*  
2017

*Document Version*  
Peer reviewed version

[Link back to DTU Orbit](#)

### *Citation (APA):*

Baruffi, F., Calaon, M., & Tosello, G. (2017). *Micro injection moulding process optimization of an ultra-small POM three-dimensional component*. Abstract from euspen Special Interest Group Meeting: Micro/Nano Manufacturing, Glasgow, United Kingdom.

---

### General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

# Micro injection moulding process optimization of an ultra-small POM three-dimensional component

Federico Baruffi<sup>1</sup>, Matteo Calaan<sup>1</sup>, Guido Tosello<sup>1</sup>

<sup>1</sup>Technical University of Denmark, Department of Mechanical Engineering, Kgs. Lyngby, Denmark

[febaru@mek.dtu.dk](mailto:febaru@mek.dtu.dk)

## Abstract

Replication-based manufacturing processes are a cost effective method for producing complex and net-shaped components [1]. Micro injection moulding has a prominent place among them for its capability of accurately and precisely produce micro plastic parts in large production scale [2], [3]. In this study, the optimization of the micro injection moulding process of an ultra-small (volume: 0.07 mm<sup>3</sup>; mass: 0.1 mg) three-dimensional Polyoxymethylene (POM) micro component for medical applications (see Figure 1) is presented. Preliminary experiments highlighted the need for venting channels in order to facilitate the evacuation of air from the micro cavity, allowing the consistent achievement of complete filling. If, on one hand, the implemented venting channel (depth: 4  $\mu$ m) solved the issue, on the other, it caused the formation of a micro-scaled flash on the part. In order to optimize the part geometry with respect to design specifications, the flash areal size was utilized as quality indicator. A design of the experiments approach was carried out in order to study the effects of melt temperature, mould temperature, holding pressure and injection speed. For this task, a two-level full factorial design was selected. The flash size (i.e. flash area) of each moulded part was characterized and measured using a state-of-the-art 3D focus variation microscope featuring sub-micrometric lateral resolution (see Figure 2). The results of the analysis show that the flash can be successfully used to highlight the most significant process parameters with respect to the part quality (see Figure 3). Being the flash area also measurable using an appropriate 2D camera, this opens the door to future in-line and cost-effective dimensional quality assurance.

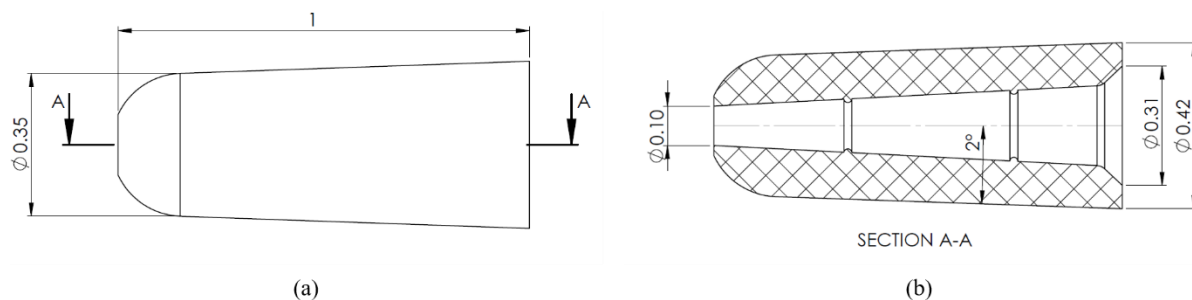


Figure 1. Geometry of the micro component

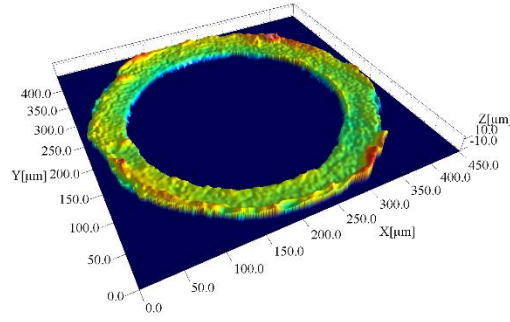


Figure 2. 3D acquisition of flash area

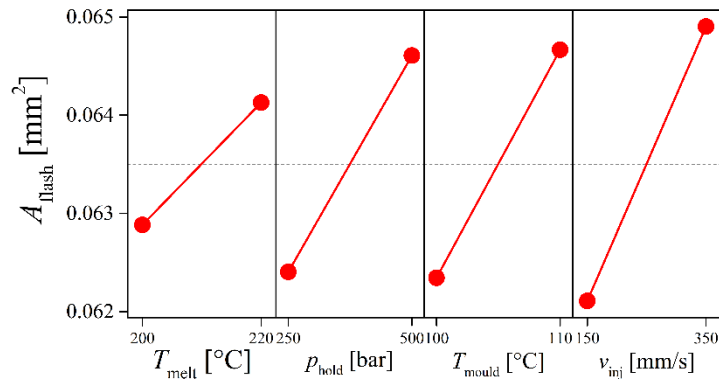


Figure 3. Main effects plot of flash area

## Acknowledgements

This research work was undertaken in the context of MICROMAN project (“Process Fingerprint for Zerodefekt Net-shape MICROMANufacturing”, <http://www.microman.mek.dtu.dk/>). MICROMAN is a European Training Network supported by Horizon 2020, the EU Framework Programme for Research and Innovation (Project ID: 674801).

## References

- [1] E. B. Brousseau, S. S. Dimov, and D. T. Pham, “Some recent advances in multi-material micro- and nano-manufacturing,” *Int. J. Adv. Manuf. Technol.*, vol. 47, no. 1–4, pp. 161–180, 2010.
- [2] J. Giboz, T. Copponnex, and P. Mélé, “Microinjection molding of thermoplastic polymers: a review,” *J. Micromechanics Microengineering*, vol. 17, no. 6, pp. R96–R109, 2007.
- [3] C. Yang, X.-H. Yin, and G.-M. Cheng, “Microinjection molding of microsystem components: new aspects in improving performance,” *J. Micromechanics Microengineering*, vol. 23, no. 9, pp. 1–21, Sep. 2013.